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Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Office of Technical Assistance

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Toxics Use Reduction Case Study

ELIMINATION OF TURA CHEMICAL REPORTING AT THE ROBBINS COMPANY

SUMMARY

By refining its manufacturing operations over a number of years, the Robbins Company eliminated or significantly reduced all chemicals previously reported for the Massachusetts TURA Form S and the EPA's Form R. Robbins' ongoing commitment to continuous improvement has helped to foster an environment open to progressive ideas and new technologies. In 1987, the company replaced its traditional wastewater treatment system with a state-of-the-art closed-loop ion exchange system. In 1994, Robbins updated and refined this process by replacing the ion exchange equipment with a reverse osmosis system that uses minimal quantities of maintenance chemicals and produces less waste. To eliminate the use of chlorinated solvents, Robbins switched in 1993 to a closed-loop aqueous cleaning system. The new system uses ultrafiltration to recycle and extend the life of cleaning baths by 300%, reducing costs associated with the purchase and disposal of the cleaner. Further, to eliminate the use of dissociated ammonia in annealing ovens, the company converted to a system that blends hydrogen and nitrogen gases. The ovens' noncontact cooling water which was once discharged to the sewer is now chilled and recirculated back to the process. Since 1986, through these changes and other toxics use reduction strategies, Robbins has reduced chemical use in wastewater treatment by 99%, reduced hazardous waste generation by 99% and cut water use by 98.5%. All told, these reductions have created an annual savings of more than $100,000, and the company no longer has to report chemical usage under TURA or chemical releases under EPCRA.

BACKGROUND

The Robbins Company is a 350-employee manufacturing company located in Attleboro, Massachusetts. The major processes performed at the facility include casting, stamping, grinding, polishing, annealing, plating, coloring and coating. Before the company began to investigate ways to conserve water, reduce its use of chemicals and cut back on its generation of hazardous wastes, Robbins had a conventional wastewater treatment system. The company's plating line was without countercurrent rinses or flow restrictors, and water poured into rinse tanks at a rate of 1.8 gallons per

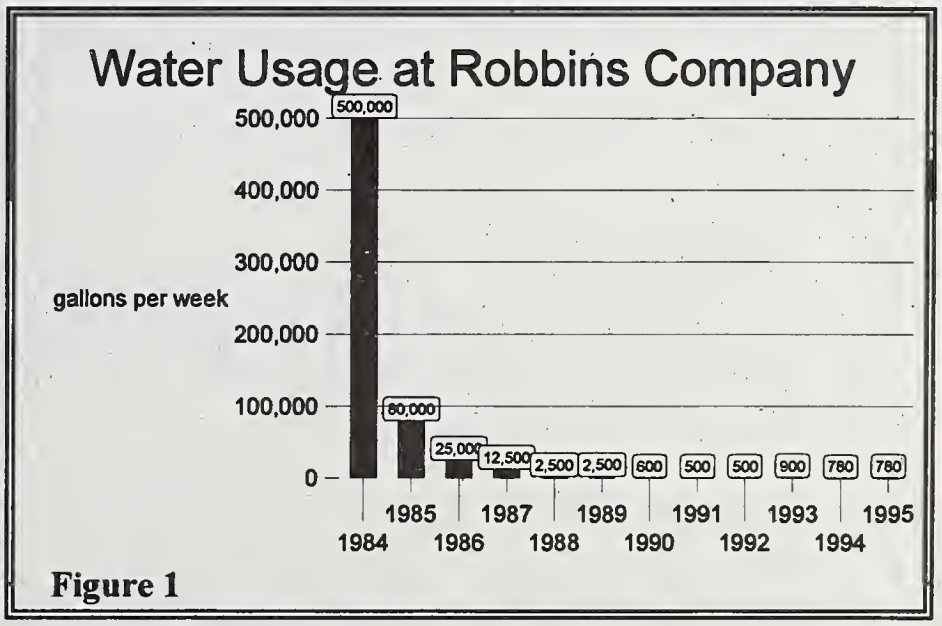


Figure 1

100% POST CONSUMER RECYCLED PAPER PRINTED WITH SOY-BASED INKS

minute. With this arrangement Robbins used 100,000 gallons of water per day (See Figure 1), multiple chemicals, including trichloroethylene (TCE) and Freon, and was a large quantity generator of hazardous waste. Robbins was also using dissociated ammonia in the annealing ovens to remove oxides and brighten the surface of jewelry manufactured at the facility.

OTA CONSULTATION

In the mid-1980s, the Office of Technical Assistance's predecessor agency - known as the Office of Safe Waste Management (OSWM) - offered workshops to jewelry manufacturers in the Attleboro area on in-process metals management and water conservation. Robbins participated in these workshops and subsequently in the OSWM-sponsored Southeast Jewelry Platers Project (SJPP). On-site environmental audits by OSWM staff aided the Robbins Company in identifying:

- chemical use and waste generation at the facility,
- additional water conservation strategies,
- alternatives to chlorinated solvent use in parts drying and cleaning, and
- metal recovery technologies.

After receiving detailed reports from the audits, Robbins used a variety of source reduction techniques to reduce the metal content of its rinse water. The company installed counter-current rinsing, and drag-out (i.e., dead rinse) tanks after plating tanks; used ion exchange to recapture metals from the cyanide process, returning clean water to the plating process tanks; changed the way that parts were racked to ensure more efficient drainage; and increased part drainage times.

In 1994, OTA again visited the Robbins Company and identified alternatives to the ammonia used in the annealing step. Robbins then took the initiative to reengineer their annealing process and to eliminate the use of ammonia, the only TURA reportable chemical still used. Additionally, noncontact cooling water from the annealing furnaces is now recirculated through a chiller and returned to the process.

TOXICS USE REDUCTION MODIFICATIONS

Elimination of Cleaning Solvents: Robbins made it a priority to eliminate ozone depleting substances and trichloroethylene (TCE), a hazardous air pollutant, from its manufacturing processes. The company has three critical points in its manufacturing process where parts require cleaning: after coloring/plating, after stamping, and after the polishing step. In the coloring/plating department, Robbins once used Freon to dry parts to a mirror finish, to ready them for packaging and shipping. TCE was used to remove oils from the stamping operation and to remove the polishing compound remaining from the buffing operation. At each of these cleaning steps, Robbins evaluated and successfully installed an aqueous alternative.

- **Coloring/Plating**: Deionized water and a hot air drying step have replaced the Freon once used following these operations. Robbins focused particularly on eliminating Freon because of the requirement from the 1987 Montreal Protocol that requires parts processed with ozone depleting substances to be labeled after 1994. Freon was eliminated in 1991, three years before the labeling requirement took effect.

- **Stamping**: A three-step aqueous cleaning station, consisting of an aqueous wash, deionized still water rinse and a hot air dry, has replaced the TCE degreaser at this process step. After the new parts washing equipment was installed, Robbins switched to lighter stamping oils to increase the effectiveness of this cleaning operation.

- **Polishing**: An aqueous, ultrasonic wash followed by several heated deionized water rinse tanks has replaced the TCE once used to remove polishing compound from the parts. After reviewing the polishing process, unnecessary cleaning between polishing steps was eliminated and parts are now only cleaned after the final polish. Robbins has installed an ultrafiltration unit that has tripled the life of the cleaning solutions used in this process.

Elimination of Ammonia in Annealing Ovens: In Robbins' annealing ovens, metal jewelry parts are heated and treated to remove metal oxides and shine the surface of the part. Ammonia is dissociated into elemental hydrogen and nitrogen to create a reducing atmosphere to prevent the formation of oxides. By 1992, ammonia was the single chemical for which Robbins was required to file reports to both the EPA's TRI program and the Massachusetts TURA program (See Figure 2). In 1994, with the aid of a detailed report developed through on-site technical assistance by OTA, the Robbins company devised a plan to eliminate its ammonia usage entirely.

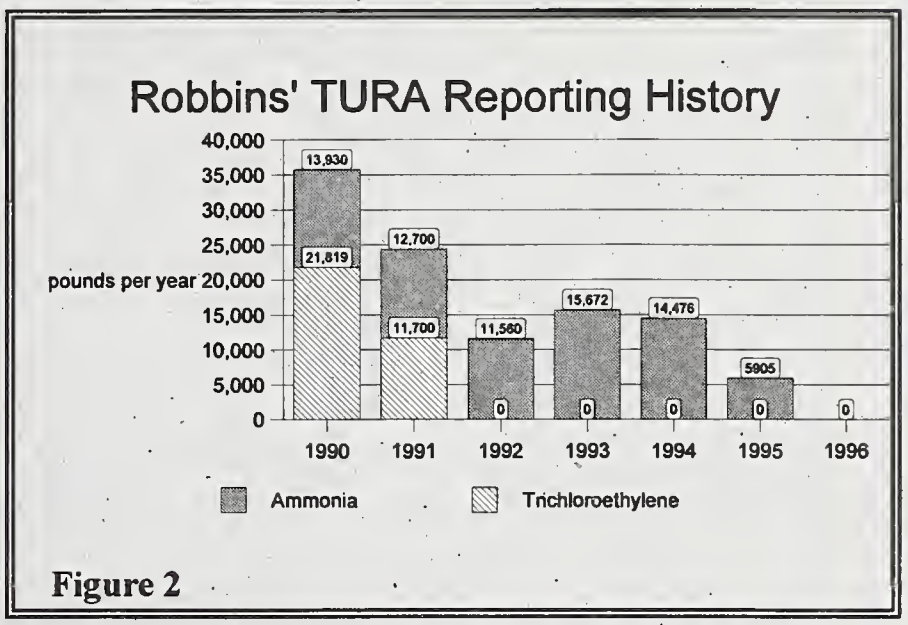


Figure 2

The ammonia dissociation process generally results in an oven atmosphere of 75% hydrogen and 25% nitrogen gas. Through trial and error, the company determined that its annealing process requires significantly less hydrogen to produce the same desired brightened finish. The company decided to take the existing ammonia dissociator out of service and install a new system where pure hydrogen and nitrogen gases are blended to produce the desired oven atmosphere. Robbins eliminated the use of approximately 14,000 lbs. of ammonia, and no longer reports any chemicals to the EPA TRI program or the Massachusetts TURA program.

Closed-Loop Water Recycling and Reuse System: Once the company had reduced water usage and metal bearing rinse water, the flow rates were low enough to make a closed-loop water treatment system economical. In 1987, Robbins replaced the traditional metal hydroxide precipitation system with a closed-loop system incorporating ion exchange to remove metals and salts from the rinse water.

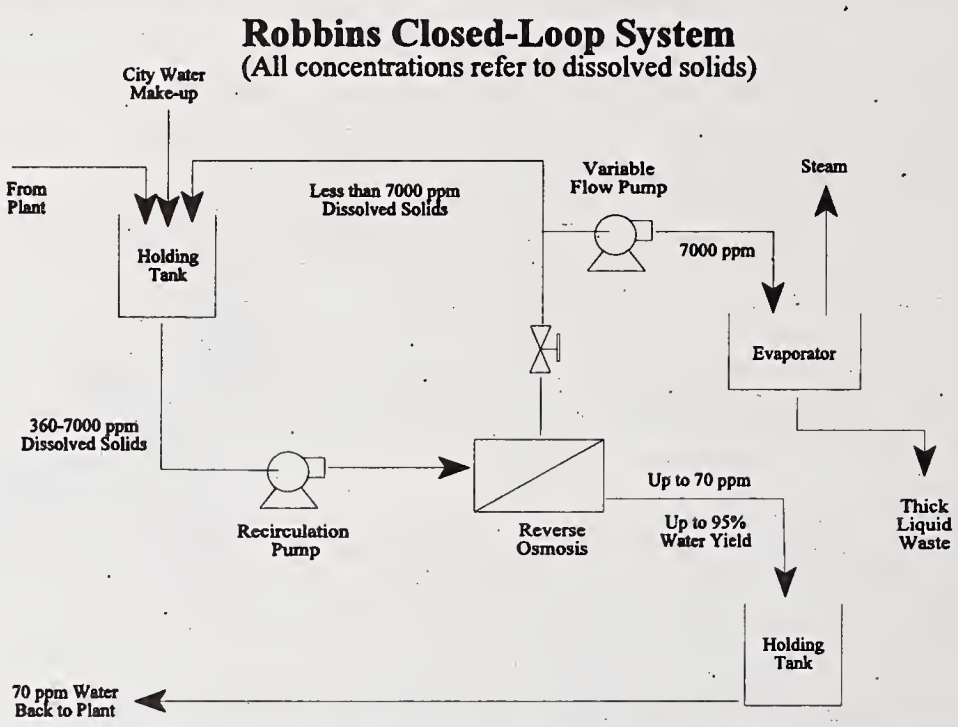
This system worked well, decreasing water usage, chemical use and hazardous waste generation. It produced water that was 40 times cleaner than city water, contributing to greater plating quality. Yet Robbins found that ion exchange still required a fair amount of supervision and that acids and bases were needed to regenerate the resin columns. The ion exchange closed-loop system still generated significant amounts of liquid waste for evaporation.

In 1994, the company replaced the ion exchange treatment system with a state-of-the-art reverse osmosis system (See Figure 3). Robbins recognized some significant benefits in switching to reverse osmosis, including:

- less operator involvement (the system requires little maintenance or monitoring),
- minimal amounts of acid required to clean the reverse osmosis filters,
- lowered worker exposure risks,
- reductions in quantities of water requiring evaporation,
- improved water quality, and
- less hazardous waste generated.

Robbins realized significant reductions in the use of sodium hydroxide and muriatic acid as a result of this change. The company's usage of sodium hydroxide was reduced from 500 gallons in 1993 to 20 gallons in 1994. Chemical use in the new system is limited to filter cleaning/maintenance only.

Figure 3



RESULTS

Summary of Reductions Achieved: Through toxics use reduction strategies, Robbins eliminated annual use of 6,000 lbs. of Freon, 21,000 lbs. of trichloroethylene, 14,000 lbs. of ammonia and 3,000 lbs. of sodium hydroxide and 2,500 lbs. of sulfuric acid used in wastewater treatment. Sludge generation was cut by 99.8%, from 4,000 gallons to 7 gallons per year, reducing the company's status from a large quantity generator (LQG) of hazardous waste to small quantity generator (SQG). In addition, by using in-process water conservation techniques, Robbins reduced its daily water consumption from 100,000 gallons in 1984 to 5,000 gallons in 1986, to just 156 gallons in 1994. City water is needed by the closed-loop system only to compensate for evaporation. These reductions continue to save the company more than $100,000 annually. These savings are derived only from lowered chemical purchase costs and lowered hazardous waste disposal costs.

This case study is one in a series prepared by the Office of Technical Assistance (OTA), a branch of the Massachusetts Executive Office of Environmental Affairs. OTA's mission is to assist industry in reducing the use of toxic chemicals and/or the generation of toxic manufacturing byproducts. Mention of any particular equipment or proprietary technology does not represent an endorsement of these products by the Commonwealth of Massachusetts. This information is available in alternate formats upon request. OTA's ***confidential, nonregulatory*** *services are available at* ***no charge*** *to Massachusetts businesses and institutions that use toxics. For further information about this or other case studies, or about OTA's technical services; contact:* ***Office of Technical Assistance, 100 Cambridge Street, Room 2109, Boston, Massachusetts 02202; phone #(617)727-3260; fax #(617)727-3827; electronic bulletin board #(617)727-5621.***